## REMARKS

Claims 1-12 and 23-34 are pending in the application. Claims 1-12 and 23-34 stand rejected. Claims 1, 23, 28 and 30 were amended. Claims 33-34 were cancelled. Claim 35 and 36 were added. Claims 1-12, 23-32, and 35-36 remain in the application.

The Examiner indicated that the previous amendment misquoted the preceding office action stating:

> 'Regarding claims 11-12, the Applicant quoted an excerpt from the Examiner's previous rejection. He wrote the rejection states:
>
> '"Carlson's invention is related to wide view images (Carlson, col. 2, line 67 - col. 3, line 1). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made for Carlson to implement a system including a processor for combining the images into a composite image..."
>
> 'Well, the Examiner respectfully disagrees. That excerpt from the Examiner's previous rejection was written as:
>
> '"...Similar to Ribera, Carlson's invention is related to wide view images (Carlson, col. 2, line 67 - col. 3, line 1). In light of the teaching of Ribera, it would have been obvious to one of ordinary skill in the art at the time the invention was made for Carlson to implement a system including a processor for combining the images into a composite image..."'

It appears that the Examiner and Applicant are working from different copies of the earlier office action. To clarify matters, copies of both office actions received by Applicant are attached to this amendment. The above-quoted language in the first office action is marked. It is assumed, for the purposes of this amendment, that the second office action remains final.

The Examiner also indicated that a copy of a reference discussed (Dictionary of Mathematical Terms, 2nd ed., D. Downing, Barron's, Hauppauge, New York, (1995), page 247) had not been included. Applicant has enclosed a copy of the missing reference with the information disclosure statement submitted with this amendment.

Claims 1-5, 8, 10, 30-31, and 33 stand rejected under 35 U.S.C. 102(b) as being anticipated by Carlson (U.S. Patent No. 4,554,585). Claims 6-7

stand rejected under 35 U.S.C. 103(a) as being unpatentable over Carlson (U.S. Patent No. 4,554,585) in view of Hsieh et al. (U.S. Patent No. 6,798,923). Claims 11-12, 32, and 34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Carlson (U.S. Pat. #4,554,585) in view of Ribera et al. (U.S. Pat. # 6,603,503). Claims 23-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Carlson (U.S. Pat. #4,554,585) in view of Huang et al. ("Panoramic Stereo imaging System with Automatic Disparity Warping and Seaming," Graphical Models and image Processing, Vol. 60, No. 3, May 1998, pp. 196-208.)

Claim 9 was not mentioned in the office action, but is listed in the summary as being rejected. To further prosecution, it has been assumed that the rejection of Claim 9 in the previous office action is repeated.

The Office Action stated in relation to Claim 1:

> "For claim 1, Carlson teaches an electronic imaging system (fig. 1, 100, 110, 108) for capturing an image of a scene (col. 2, lines 57-62), said imaging system comprising:
>
> "(a) an optical system (fig. 1, 100) for producing an optical image of the scene (col. 2, line 63 - col. 3, line 10);
>
> "(b) an imaging sensor (solid-state imager, col. 2, lines 63-65) having a surface in optical communication (col. 2, line 66 - col. 3, line 2) with the optical system; and
>
> "(c) a plurality of imaging elements (fig. 2a) distributed on the surface of the imaging sensor (col. 4, lines 13-23), said imaging elements converting the optical image into a corresponding output signal (col. 3, lines 4-7), said imaging elements being located according to a distribution representable by a nonlinear function in which the relative density of the distributed imaging elements is greater toward the center of the sensor (col. 4, lines 28-33), wherein the distribution provides physical coordinates for each of the imaging elements corresponding to a projection of the scene onto a non-planar surface (col. 4, lines 24-28); wherein said optical image produced by the optical system has a perspective distortion relative to the surface of the imaging sensor and the distribution of imaging elements on that surface compensates for the perspective distortion. Please read Carlson's Abstract, col. 4, lines 24-28, and col. 5, line 14 - col. 6, line 9."

The office action also stated:

'In regards to claim 1, the Applicant also states that the optical image produced by the optical system has a perspective distortion relative to the surface of the imaging sensor and the distribution of imaging elements on that surface compensates for the perspective distortion of the optical image. After explaining what Carlson's imaging system is applicable thereto, the Applicant states that distortion is not addressed. The Examiner respectfully disagrees. In several places throughout Carlson's disclosure, he teaches how to compensate for blurring and aliasing, which corresponds to distortion and warping, with respect to the pattern of the picture element of the imager. Please read Carlson's Abstract and col. 5, line 14 - col. 6, line 9.'

Amended Claim 1 states:

1. An electronic imaging system for capturing an image of a scene; said imaging system comprising:

(a) an optical system producing an optical image of the scene;

(b) an imaging sensor having a surface in optical communication with the optical system; and

(c) a plurality of imaging elements distributed on the surface of the imaging sensor, said imaging elements converting the optical image into a corresponding output image, said imaging elements being located according to a distribution representable by a nonlinear function in which the relative density of the distributed imaging elements is greater toward the center of the sensor, wherein the distribution provides physical coordinates for each of the imaging elements corresponding to a projection of the scene onto a non-planar surface, wherein said output image has a plurality of pixels, each said pixel corresponding to a respective one of said imaging elements;

wherein said optical system provides a perspective projection of said optical image onto said surface, said optical image has a perspective distortion relative to said surface, said perspective distortion being inherent in geometry of said perspective projection onto said surface, and said distribution of said imaging elements on said surface of

said imaging sensor compensates said output image for said perspective distortion, such that said output image is free of said perspective distortion and has said pixels in a uniform rectilinear array.

The changed language is supported by the application as filed, notably the original claims and at Figures 4-5; page 8, line 17 to page 10 line 14; page 1, lines 22-26; page 6, lines 23-30; page 2, lines 9-14; page 4, line 14 to page 5, line 5.

Claim 1 requires:

"said optical system provides a perspective projection of said optical image onto said surface, said optical image has a perspective distortion relative to said surface, said perspective distortion being inherent in geometry of said perspective projection onto said surface, and said distribution of said imaging elements on said surface of said imaging sensor compensates said output image for said perspective distortion, such that said output image is free of said perspective distortion and has said pixels in a uniform rectilinear array."

The cited compensation in Carlson for blurring and aliasing does not meet the language of Claim 1. A definition of "blur" states:

"BLUR Image unsharpness, such as that caused by inaccurate focusing or movement of the subject or the camera during exposure of the film." *The Focal Encyclopedia of Photography*, 3rd Ed., L. Strobel and R. Zakia, Focal Press, Boston, (1993), page 59.

A definition of "aliasing" states:

"If the function is *undersampled*, then a phenomenon called *aliasing* corrupts the sampled image. The corruption is in the form of additional frequency components being introduced into the sampled function." *Digital Image Processing*, R. Gonzalez and R. Woods, Prentice Hall, Upper Saddle River, New Jersey, (2002), page 62.

These definitions show that the blurring and aliasing of Carlson do not relate to the distortion inherent in geometry of a perspective projection. A textbook describes such distortion:

"A real optical system causes deviations from a perfect perspective projection. The most obvious *geometric distortions* can be observed with simple spherical lenses as barrel- or cushion-shaped images

of squares. Even with a corrected lens system these effects are not completely suppressed.

"This type of distortion can easily be understood by considerations of symmetry. As lens systems show cylindrical symmetry, concentric circles only suffer a distortion in the radius." *Digital Image Processing*, B. Jahne, Springer, Berlin, (2002), page 190.

The office action mentions "warping", another term used in the application:

"blurring and aliasing, which corresponds to distortion and warping".

The term "warping" also refers to a geometric change, which is again unlike blurring and aliasing:

"warping. Geometric stretching and shrinking of an image. Unlike pure scaling, the degree of size change varies from place to place over the image." *Practical Digital Image Processing*, R. Lewis, Ellis Horwood, New York, (1990), page 252.

Claim 1 further requires that the output image has pixels in a uniform rectilinear array, that each pixel corresponds to a respective one of the imaging elements, and that the distribution of the imaging elements compensates for the perspective distortion. Carlson does not disclose and does not even recognize the possibility of this feature. In Carlson, the embodiments of Figures 2a, 2b, and 3 have spatial patterns that are "scale invariant"; in effect, the spatial patterns shown for the imagers are retained in the resulting images. Carlson states:

'The term "scale invariant," as used herein, means that both object shape and object spatial resolution in a picture derived from a processed image of an object, are substantially independent of any magnification or demagnification of object size in the image." (Carlson, col. 2, lines 37-41)

"The respective substantially scale-invariant spatial distribution patterns shown in FIGS. 2a and 2b are meant only as examples." (Carlson, col. 4, lines 57-59)

"Referring to FIG. 3, there is shown an imager 300 having a substantially scale-invariant spatial distribution pattern of discrete picture elements similar to that shown in either FIG. 2a or FIG. 2b." (Carlson, col. 5, lines 13-16)

In Carlson, the scale invariant spatial distribution patterns provide non-uniform picture elements. The reason for this is to reduce the signal processing burden:

> "In accordance with the principles of the present invention, relatively high spatial resolution is provided solely within the limited extent of central region 104 of field of view 102. Within those portions of field of view 102 falling outside of central region 104 only relatively low spatial resolution is provided. This greatly reduces the total number of samples to be processed, permitting a smaller, less-expensive, more practical signal processor 108 to be utilized, without affecting the ultimate spatial resolution capability of the imaging system." (Carlson, col. 3, lines 56-65)

In Carlson, the non-uniform picture elements can correspond to single non-uniform photodetecting elements, as shown in Carlson Figures 2a and 2b, or to non-uniform groups of elements in combination with integrating circuitry. Carlson states:

> "Furthermore, the spatial distribution pattern of discrete picture elements can be derived directly, as in FIGS. 2a and 2b, in which each picture element is comprised of a single photodetecting element of a solid-state imager. Alternatively, this pattern can be realized indirectly by means of appropriate integrating circuitry operating on a photodetecting signal derived from different subareas of the photodetecting surface. In the latter case, either a continuous photodetecting surface of a vidicon or a solid-state imaging chip having photodetectors all of the same size, the size being equal to or smaller than the size of the highest resolution image sample of the spatial distribution pattern to be realized." (Carlson, col. 4, line 67 to col. 5, line 12)

Claim 1, in contrast, calls for an output image having pixels in a uniform rectilinear array, in which each pixel corresponds to a respective one of the imaging elements, and the distribution of the imaging elements compensates for the perspective distortion.

Claims 2-12 are allowable as depending from Claim 1 and as follows.

Claim 23 is allowable on the grounds discussed above in relation to Claim 1.

Claims 24-27 are allowable as depending from Claim 23.

Claim 28 is allowable on the grounds discussed above in relation to Claim 1.

Claim 29 is allowable as depending from Claim 28.

Claim 30 is allowable on the grounds discussed above in relation to Claim 1.

Claims 31-32 are allowable as depending from Claim 30.

Claims 33-34 were cancelled.

Claims 35-36 are supported and allowable on the same grounds as the earlier listed claims.

It is believed that these changes now make the claims clear and definite and, if there are any problems with these changes, Applicants' attorney would appreciate a telephone call.

In view of the foregoing, it is believed none of the references, taken singly or in combination, disclose the claimed invention. Accordingly, this application is believed to be in condition for allowance, the notice of which is respectfully requested.

Respectfully submitted,

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